Effects of habitat alteration and seasonal variation on the abundance and diversity of Pterygota at Cloudbridge Nature Reserve, Costa Rica.

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Abstract

This study collected data to follow up Neil Rosser's (2006) study with the goal of comparing abundance and diversity of insects across the dry and wet seasons in a Costa Rican Cloud forest. To compare habitat variation, 8 samples were taken from three different habitat types: primary forest, 3 year old plantation and recently deserted cow pasture. The insects were attracted by ripe banana and sugar water. The primary forest traps recovered the most insects and the plantation least. When the dry season data was compared to that of the wet, there was a striking variation in the abundance of primary forest insects especially Diptera. Other orders did not show such variation, nor did the other habitat types. Habitat alteration seems to have large effects upon insect abundance and diversity and a 3 year old forest does not diminish these changes.

Introduction

The primary purpose of this study is to continue Rosser's (2006) study of Pterygota during the dry season of Costa Rica. I will continue to test the original two hypotheses: "diversity of insect groups would reduce with increasing levels of habitat alteration" and "abundance of insect groups would vary between habitat types." Since the second set of data was collected during the Costa Rican dry season, we will be able to get a more complete picture of insect diversity by accounting for seasonal variation.

In the tropical climate of Costa Rica, the dry and wet seasons play huge biological roles in species development. Develey (2000) found that forest dwelling arthropods were most abundant during the rainy season which leads to the conclusion that arthropods generally are more active during the rainy season. It has also been found that species diversity of Lepidoptera is significantly higher during the dry seasons in a primary forest. (Hammer et al. 2005) However, in forests that had been selectively logged, Lepidopteran abundance did not vary much through the year suggesting that temporal variation does not have equal effects on modified habitats.

Methods

Following the methodology of Rosser (2006), the traps were fashioned out of 1.75 liter water bottles with a 6.4 x 2.5 cm hole allowing the insects to enter. One sliced banana was added to six heaping tablespoons of white granulated sugar which had been dissolved in 1200 ml of water. The mixture was stirred for 20 seconds.

Each trap was set for four hours between approximately 8:00 am and 12:00 pm at Rosser's (2006) sites: 3 different primary forest sites, 3 in a 4 year-old tree plantation and 3 in recently retired pastureland. Each of the 9 traps was placed along a trail traversing the length of the individual habitat parcels. The first site was at the lowest in elevation and the third was at the highest. Data collection began January 5, 2006, 38 days after the end of Rosser's collection, during the height of the dry season and continued until January 30, 2006 .

Identification of Specimens

Whenever possible, a microscope was used to identify each individual specimen's order. Due to a lack of literature, only Hymenoptera and Coleoptera were further classified into family.

Results

As seen in Graph 1, the most insects were collected in the primary forest (54) and the fewest gathered in the plantation (20). Diptera was the most common order, followed by Coleopteran(25), Hymenopteran (20), Aelothripidae (2), Ordonata (1) and Orthoptera (1). Coleoptera (33 and Diptera were most populous in the primary forest while Hymenoptera had an equal number of individuals in the forest and the pasture land (8).

Utilizing the data collected in Rosser (2006), I noticed a vast disparity between number of insects collected during the rainy (163) and the dry (54) seasons. However, neither the pasture nor the plantation shows such a disparity: in the pasture during the rainy season 19 individuals were trapped and 20 in the dry season; in the plantation, 33 were collected in the rainy and 36 in the dry. Diptera was by far the most common order during both collections but the abundance varied greatly between the two seasons. During the dry season, only a fourth of the total diptera were collected (Graph 2). Coleoptera (25) and Hymenoptera (20) were more abundant during the dry season rather than the rainy season, 14 and 14 respectively (Graph 3 and 4).

Discussion

The primary forest traps collected far more insects than either the plantation or pastureland. Several factors could cause this discrepancy: there is more plant diversity, cooler temperatures, and a moister habitat. Additionally, the primary forest has never been cut down unlike the other habitats. During the rainy season, the primary forest yielded nearly three times as many insects as they did during the dry season, while the traps in both modified habitats collected the same number of insects throughout the season. As discussed earlier, similar effects were found in the Brazilian forest with Lepidoptera (Hammer et al. 2005). Since insect abundance varies by season, bird migratory schedules probably are also affected (Devely, 2000). If the dry season insect population becomes the static year round population, it is possible that birds would not have sufficient food to complete their breeding cycles and migrations.

Diptera, Coleoptera and Hymenoptera

During the dry season, Diptera continued to be most common in the primary forest despite huge discrepancies between Dipteran abundance in the dry and the wet seasons. The two modified habitats maintained similar numbers during both seasons indicating Habitat alteration as a likely explanation for the variation. Additionally, these results hold true to Rosser's (2006) theory that Diptera are most commonly trapped in rainy weather. The number of Diptera collected varied across all habitats. During the rainy season, Diptera were far more common in the forest than in any other habitat.

During the dry season, Coleoptera were most commonly found in the primary forest, followed closely by the pasture. However, when combined with the data from the rainy season, Coleopteran were significanly more common in the pasture than in the primary forest. Perhaps, higher concentrations of foliage and shade in the primary forest (Rosser, 2006) lead to a moister and cooler climate than the exposed grass covered habitats of the pasture and plantation. If Coleopteran tough exoskeleton indeed provides protection against dessication (Rosser, 2006), there would be less competition with unprotected arthropods in the exposed habitats.

The fact that Hymenoptera and Coleoptera were equally abundant in the pasture and primary forest implies that habitat modification has less of an impact on them than it does on the other orders. Since neither's abundance varied between the rainy and dry seasons in the primary forest, their bodies may not be affected by variations in humidity. If habitat modification only entailed variations in humidity, neither order would be badly affected.

Recovery of the plantation

The most recently collected data, contradicts Rosser's statement that Coleopteran abundance in the plantation closely mimicked that of the primary forest. In nearly all orders, fewer insects were collected in the plantation than in the pasture or the forest. This data leads to the belief that the plantation is not becoming a habitat for increasing biological diversity. However, as the planation is only 2-3 years old, a measure of succesional change may be premature. If data continues to be collected, it will be interesting to note the number of years it will take the plantation to follow the trends found in the primary forest.

Conclusions

The results of this study do not support Rosser's original hypothesis that "number of insect groups recorded would decrease with increasing habitat alteration." The second hypothesis, "that abundance of insect groups would vary between habitat types" appears to be valid.

The biseasonal data collected provides many more avenues for study: year-round data collection; measurements of insect abundance in relationship to temporal variation; the relationship between plantation age and succesion.

Acknowledgements

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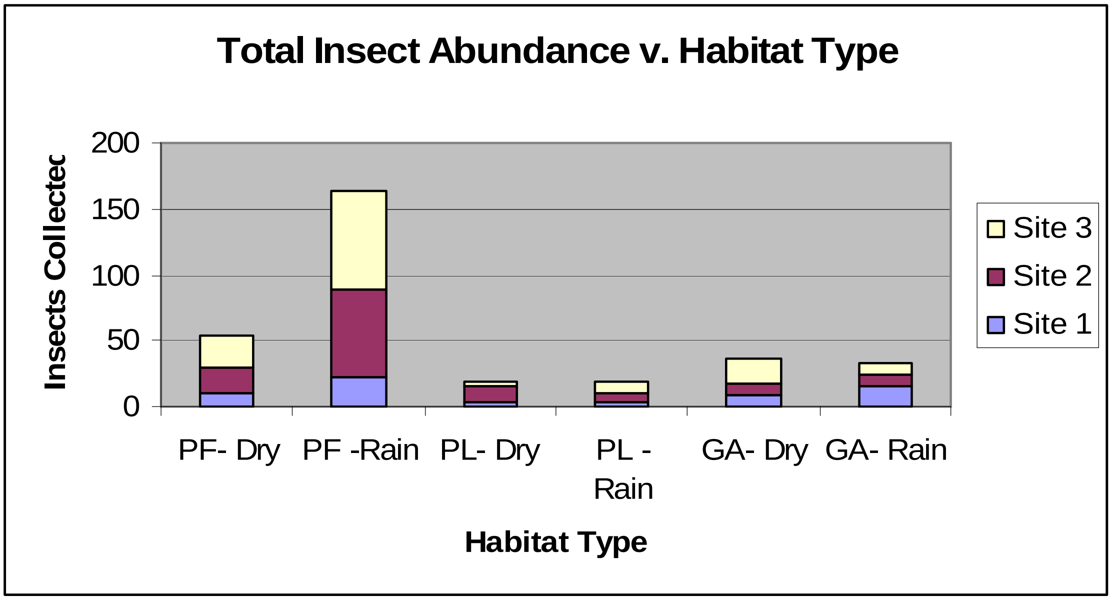
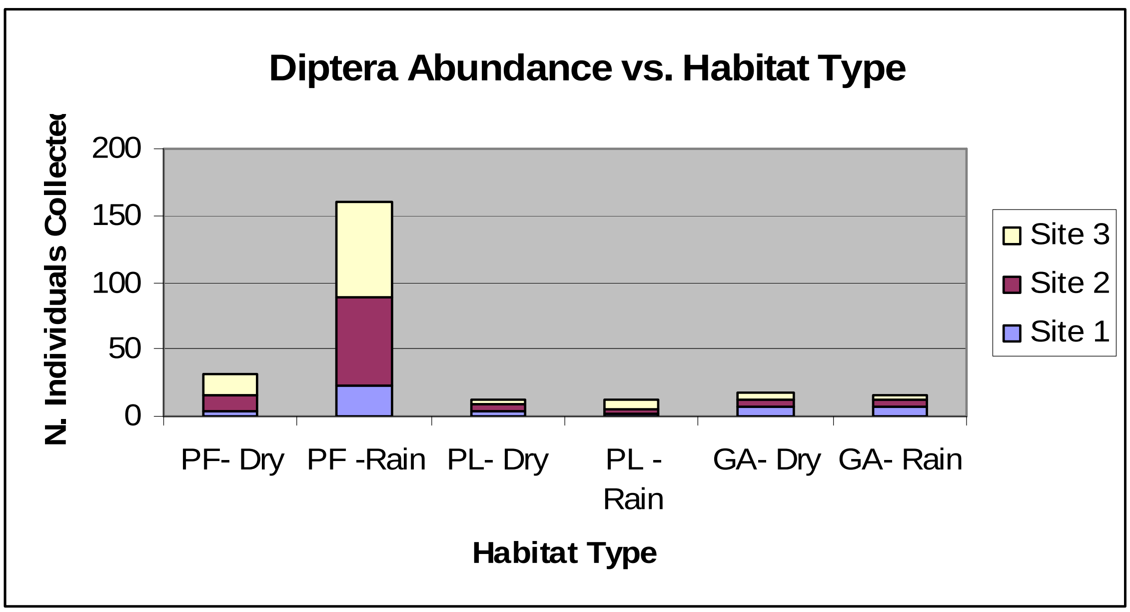
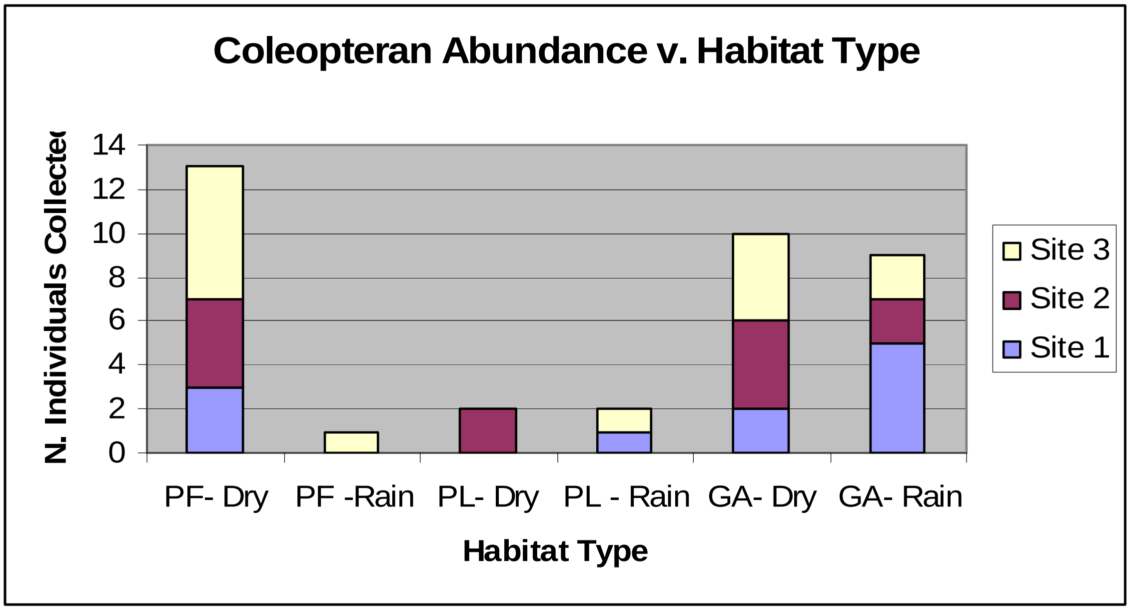


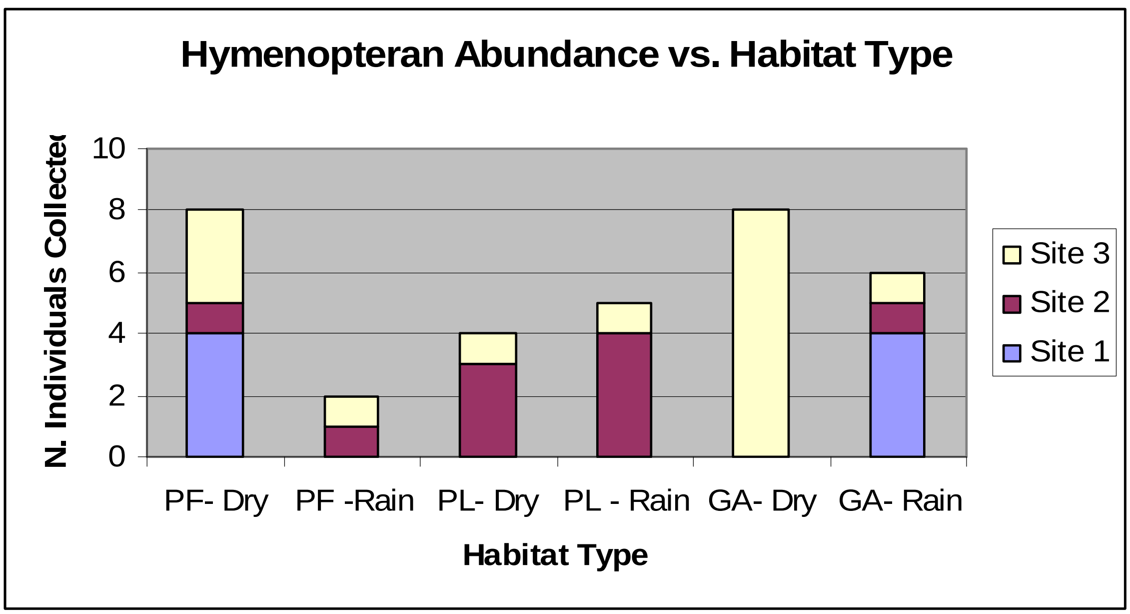
Graph 1 *shows total insect abundance dependence upon habitat type. The most significant detail is the differing number of insects collected in the primary forest (PF) during the two different seasons while the Plantation (PL) and Pasture (GA) show no such discrepency.*



Graph 2 *depicts diptera abundance with respect to habitat type. Here, we once again see that diptera are equally variable in the primary forest during the two seasons, while the numbers are approximately equal in the other two habitats.*



Graph 3 depicts Coleopteran abundance versus habitat type. Temporal variation of insect abundance is noticeable in the primary forest and almost nonexistent in the modified habitats.



Graph 4 *relates Hymenopteran abundance with respect to habitat type, showing an equally large variance between the primary forest's rainy and dry seasons, but a less constant ration between the other two habitats in the different seasons.*

Sources

Devely, PF, Peres CA. "Resource seasonality and the structure of mixed species bird flocks in a coastal Atlantic forest of southeastern Brazil." Journal of Tropical Ecology. 2000: 33-53.

Hamer KC, Hill JK, Mustaffa N, Benedick S, Sherratt TN, Chey VK, Maryati M. "Temporal variation in abundance and diversity of butterflies in Bornean rain forests: opposite impacts of logging recorded in different seasons." Journal of Tropical Ecology 2005: 417-425.

Rosser, Neil. "Effects of habitat alteration on the abundance and diversity of Pterygota at Cloudbridge Nature Reserve, Costa Rica." Published at www.cloudbridge.org. 2006.

Yanoviak SP, Kragh G, Nadkarni NM. "Spider assemblages in Costa Rican cloud forests: Effects of forest level and forest age." Studies on Neotropical Fauna and Environment 32003: 145-154